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Water Temperature Monitoring System In IoT Based Freshwater Fish Farms

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Abstract

This research develops an Internet of Things (IoT)-based water quality monitoring system for freshwater fish farming that integrates several key sensors: DS18B20 for temperature measurement, turbidity sensor for water turbidity measurement, and ultrasonic sensor for water level monitoring. The system is equipped with two automatically controlled water pumps to maintain optimal conditions in the fish pond. The system works by reading water quality parameters in real-time using these sensors, then sending the data to the IoT platform via a WiFi network. The data is processed by an ESP32 microcontroller that will automatically activate the water pump when it detects a parameter change that exceeds a specified threshold and provides notifications to the farmer via a mobile application. Test results show that this system is able to automatically monitor water temperature and turbidity levels in pond water based on the temperature and turbidity data obtained

***Keywords**: System, Temperature, Fish, IoT, Sensor.*

1. Introduction

Indonesia is a country rich in natural resources, particularly water, which is highly advantageous for various types of businesses, both primary and secondary. Fish is a favorite food for Indonesians due to its affordability and high nutritional content. Fish plays a significant role in meeting nutritional needs and supporting community food security [1].

The benefits of fish as a source of livelihood, food security, and health cannot be optimally achieved without meeting good cultivation standards. Water quality is one of the most influential factors in the success of both processes. However, the country's abundant natural water resources are often threatened by environmental pollution. For example, in urban areas, waste from factories or inadequate waste management in landfills can pollute surrounding water sources [1].

Water that does not meet standards can negatively impact crop yields and lead to cultivation failure. Several factors influence water quality, including temperature. The ideal temperature for freshwater fish farming ranges from 25°C to 30°C[2].

The main problem in the aquaculture sector is the water quality control system, which causes pests and diseases in the water of the cultivation ponds. One factor that is very decisive for the success of cultivation is water quality control because according to studies, around 60% - 70% of the causes of fish deaths in inland aquaculture are due to poor water quality control, so the problem of water quality in the world of inland aquaculture is a problem that requires special attention. In addition, 80% of inland aquaculture still uses traditional methods to control water quality. Based on news released by the Department of Animal Husbandry and Fisheries of Bogor Regency, it is informed that mass deaths in fish farming ponds are still often caused by a decline in pond health which causes stress to the fish, which leads to death[3].

1.1 Problem Formulation

The problem formulation in this research is as follows:

1. What factors influence water quality in freshwater fish farming?
2. How can an effective air temperature monitoring system be created to improve the quality of fish farming?
3. What are the challenges faced in controlling water quality in freshwater fish farming?

1.2 Research Objectives

The benefits of this research are expected to benefit various stakeholders, including:

1. Identifying the challenges faced in monitoring water temperature in freshwater fish farming.
2. Creating an effective water temperature monitoring tool to ensure water quality is maintained.

3. Identifying factors that influence water quality in freshwater fish farming.

2. Literature Review

2.1 Internet of Things

IoT or what is called the internet of things is a technology discovered by Kevin Ashton in 1999. How the internet of things works is that every object that has a sensor or internet of things module installed sends data or information to users via the internet and can be accessed anytime and anywhere without being limited by distance. The function of the internet of things itself is to facilitate monitoring and control of an object in everyday life. In addition, the information obtained can be at any time on the internet of things[4]

2.2 Sensors DS18B20

The DS18B20 temperature sensor is a temperature sensor that has a digital output. The DS18B20 has a fairly high level of accuracy, namely 0.5°C in the temperature range of -10°C to +85°C. Temperature sensors generally require an ADC and several port pins on the microcontroller, but the DS18B20 does not require an ADC to communicate with the microcontroller and only requires 1 wire.[4]

2.3 Sensors Turbidity

A turbidity sensor is a sensor designed to measure the level of turbidity in water. This turbidity sensor uses light to detect suspended solids in water by measuring the level of light transmission and the level of light scattering which changes according to the amount of TTS (Total Suspended Solids). In a turbidity sensor, the sensor output voltage will change as the water turbidity level increases[5]

2.4 Esp 32

This is a low-power system-on-a-chip microcontroller with dual-mode Wi-Fi and Bluetooth. The ESP32 is the core of this project. It is a microcontroller board used to connect all the sensors. The board is programmed with source code to run the project. The source code is stored in the on-chip memory available on the ESP32. This block can be considered the interface between the programmer and the user. Therefore, it is considered the core of the project. The operating voltage range of the ESP32 is 2.2 to 3.6V. In normal operation, the ESP32 will power the chip at 3.3V[6]

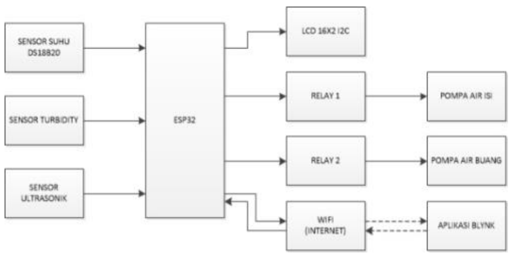

Fig. 1: System Block Diagram

This IoT monitoring system block diagram shows the relationship between the ds18b20 sensor and the ESP32 module as the main data processor or controller in the system.

3. Research Methods

A water temperature monitoring system for freshwater fish farms uses the Internet of Things (IoT), which includes planning, testing, and implementation. This tool is designed to inform fish farmers about the best water temperature quality.

This monitoring system requires an internet connection, where the DS18B20 sensor measures water temperature and a turbidity sensor monitors water quality. After that, the WiFi connection is used, and data from the sensor is sent to the Esp-32, which is the main requirement in designing this monitoring system for processing. After that, the data results will be displayed on the LCD. If the water temperature is abnormal, the Mini pump will replace the pond water so that the temperature in the pond water returns to normal. Then the Esp-32 will send data to the Blynk application via WiFi. Users can also monitor it through the Blynk application on their smartphones.

3.1 System Flowchart

The design of this tool began with the creation of a flowchart to facilitate the planning and development of the program on the microcontroller. This flowchart serves to facilitate understanding of the tool's working process. The program flowchart can be seen in Figure 2.

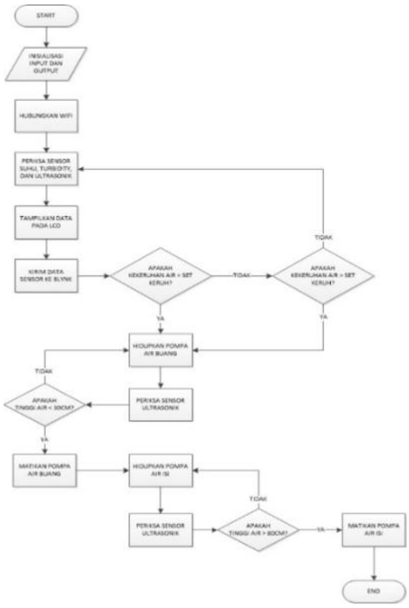

Fig. 2 : System Flowchart

4. Result and Discussion

4.1 Decision Making Logic

If the water turbidity exceeds what is set then the pump will turn on to fill and dispose of water

4.2 System testing

The main objective of this research is to create a system that can integrate and automatically manage pond water quality. By utilizing IoT, this system can provide real-time data to users, so they can take necessary actions to maintain air quality. The results showed that pond water temperature is unstable if it is below 20 degrees Celsius or exceeds 30 degrees Celsius. Unstable air temperature can affect the pond ecosystem, including the health of fish and other organisms. Therefore, continuous temperature monitoring is crucial to maintain optimal conditions. This research also developed a system that can detect air turbidity levels. When turbidity exceeds a predetermined limit, the system automatically activates a pump to replace the air. This is a proactive measure to maintain air quality and prevent larger problems in the future. The system is equipped with an ultrasonic sensor that regulates the air level in the pond. During the filling process, the sensor limits the air level to 80 cm from the bottom of the pond, while during the discharge process, the limit is set at 30 cm. This setting is important to prevent overfilling and ensure the pond is not under-aired. The results of monitoring temperature, turbidity, and air level are displayed in the Blynk application.

Fig. 3: System Testing

Table. 1: Temperature and Turbidity value

NO	Temperature and Turbidity value	Pump Condition	Blynk Display
1	27^0C ,1074	Off	**Water temperature 270C Water height 80cm, Standby status**
2	27^0C ,1244	On	**Water temperature 27OC Water height 30cm, Status: Draining**
3	27^0C,1340	On	**Water temperature 27OC Water height 80cm, Water content status**

5. Conclusion

The test results show that this system is able to automatically monitor water temperature and turbidity levels in pool water based on the temperature and turbidity level data obtained.

1. A monitoring system that uses a DS18B20 sensor for temperature, a turbidity sensor for turbidity, and an ultrasonic sensor for water level, enables more efficient water quality management. With real-time monitoring, farmers can take immediate action if changes occur that could endanger fish health.

2. The integration of two pumps for filling and draining water into this system provides significant automation. This not only reduces manual workload for farmers but also ensures optimal water conditions for fish growth, thereby increasing farm productivity.

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